International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN (P): 2249-6890; ISSN (E): 2249-8001
Vol. 8, Issue 2, Apr 2018, 811-818

Original Article

FABRICATION OF METAL MATRIX COMPOSITE FOR BRAKE DRUM-A CHARACTERISTIC STUDY OF TRIBOLOGICAL PROPERTIES

MANIKANDAN. A & PARTHIPAN. N

Department of Mechanical Engineering, M. Kumarasamy College of Engineering, Karur, Tamil Nadu, India

ABSTRACT

The brake system is the most important system in vehicle. While applying brake, thermal energy is produced from the kinetic energy. The main functions of brake drums are to slow down the speed of the vehicle, when the brake is applied. The brake drum material will be of heavy weight for the good performance. This work deals with the weight reduction in the brake drum material and also to achieve the high performance by using the composite materials. In order to achieve weight reduction in materials, the light-weight high performance components are increasingly using aluminium, magnesium, plastics and composites. Light weight and high strength component is made by Hybrid composite material. The use of Hybrid composite is becoming a viable solution to help the new system of the Automobile industry. In this Project, fabrication of metal matrix composite (AA6061+SiC+Gr) is done for automotive brake drum to attain weight reduction, corrosion resistance, thermal corrosion and also resisting temperature rise while applying brake force. The composition of the material is in different weight proportions, named as sample 1 and Sample 2. Frictional force is caused due to the sliding of two surfaces, which results in the heat energy from kinetic energy. After the fabrication of composite material for the brake drum, it was tested by using pin-on disc equipment for friction wear. The test result shows that the improved strength with light weight material and corrosion resistance is reduced in one of the sample.

***KEYWORDS:** Brake Force, Brake Drum, Friction, Metal Matrix Composites & Weight Reduction*

Received: Feb 20, 2018; **Accepted:** Mar 03, 2018; **Published:** Mar 15, 2018; **Paper Id.:** IJMPERDAPR201892

INTRODUCTION

A drum brake is a brake in which, usages pounding is caused by a course action of shoes or pads that press outward against a turning chamber part, called a brake drum. The term drum brake for the most part suggests a brake, in which, shoes push on the internal surface of the drum. When shoes press the drum, it is regularly called an attach brake. Where the drum is pressed between two shoes, similar to a conventional plate brake, it is on occasion called a crush drum brake; however such brakes are mainly for the energy. A belt or band brakes is usually used around the outside of a drum. Remembering the ultimate objective to grow the capability of operation and better handiness, the brake drum material should satisfy the going with necessities:

- Light weight
- Good wear protection
- Good warm conductivity
- High quality to weight proportion

- Free from rust
- Easy to cast
- Easy to machine
- Non attractive
- Non harmful

Brake drum ought to be planned and created with such highlights to fulfill the above necessities. Rising fuel costs, shorter ceasing separation necessities, and the development in half breed vehicles, all prompt an expanded request in lightweight vehicle segments. Changing business sector needs to create inventive items. One inventive item is a lightweight aluminum metal grid composite (MMC) brake drum that is generously lighter than the customary cast press item.

The circle cast press with sharp surface embedded by aluminum, gives a solid attachment aluminum and high warmth exchange to aluminum. The outcomes demonstrated that the heap and the sliding separation influence the wear rate of the amalgams, and the wear rate expanded with expanding load for both the composites by M.S.Kaiser(2014). The size and volume portions of the MMC fortifications, wear and scraping qualities and additionally elasticity were assessed by Vinoth M.A (2014). The required material properties for motor applications are more prominent quality, light weight, controlled warm development, high warm conductivity and great wear protection by M.Asif (2010). Proposed aluminum based composites with bring down wear protection have better tribological properties by Jayakumar (2014). Fortified practically reviewed aluminum network composite barrels and non-strengthened aluminum chambers by centrifugal casting to get the microstructure and mechanical properties for assessment by J.JenixRino (2012). Aluminum composites are broadly utilized as a part of aviation and car enterprises, because of their low thickness and great mechanical properties, better consumption protection and wear, low warm coefficient of development when contrasted with regular metals and alloys by Rajeshkumar Gangaram Bhandare (2013).Parthipan et al investigated various input and output parameter uesd in drilling optimization in SS317 material, it will be developed in better surface roughness (2016). Development of Metal Matrix Composite for Brake Drum was by Manabu Fujine (2008). The Advanced Materials Manufacturing & Characterization was done by Ananda.G.K (2013)

EXPECTABLE EFFECT

Enhanced Cooling: Heat exchange is superior to the present item,

Enhanced Roundness: Effect is in reducing the brake noise and judder.

PROBLEM IDENTIFICATION

The following effect of failures identified in the brake drum.

- Friction, wear failure Brake Drum.
- Thermal expansion of drums.
- Temperature rise while applying brake force
- Brake Drum weight.

- Corrosion of sliding places.

Figure 1: Wear Failure

Figure 2: Corrosion

METHODOLOGY

STEP 1: Problem Identification

STEP 2: Preparation of Materials in Various Compositions

Base materials of AA 6061 with reinforcement of Sic, Gr to be mixed with different mixture.

STEP 3: Casting of Materials

Bottom pouring type stir casting machine used melting the materials at 900oC to casting.

STEP 4: Machining Of Work Pieces

The work piece should be machined at required dimension depends on the testing process.

STEP 5: Testing of Friction & wear properties

Test work piece machined at the ASTM International standard size and testing the Impact strength and hardness of the specimen.

EXPERIMENTAL PROCEDURE

Table 1: Stir Casting Furnace Specification

Specification	
Furnace temperature	900 ^{0}C
Stirrer speed	600 rpm
Metal Melting Temp	810 ^{0}C
Reinforcement Pre heating Temp in ^{0}C	600 ^{0}C
Stirrer Timing	5 min

Table 2: Stir Casting Furnace Condition

Sample	Furnace Temp in ^{0}C	Melting Temp in ^{0}C	Stirrer Speed in RPM	Stirrer Timing in min	Reinforcement Pre Heating Temp in ^{0}C
Sample 1	800-830	760-790	750	5	550-570
Sample 2	800-830	750-790	750	5	616– 627

RATIO OF REINFORCEMENT MATERIALS

Table 3: Ratio of sample 1

S. No	Materials		Composition (wt %)
1	Base material	AA6061	97%
2	Reinforcement	SiC	2%
		Gr	1%
3	Total		100%

The base material of AA6061 is used for better application, and 6061 is a precipitation hardening aluminium alloy. Reinforcement of Sic, Gr is added to improving the hardness and its physical properties.

Table 4: Ratio of Sample 2

S. No	Materials		Composition (wt %)
1	Base material	AA6061-T6	97%
2	Reinforcement	SiC	1%
		Gr	2%
3	Total		100%

The base material AA6061 is 97% and the Reinforcement of Sic (1%), Gr (2%) is added for increasing the hardness and its properties.

RESULTS AND DISCUSSIONS

Friction & Wear Test

The force resists to relative motion of sample work pieces, to determine the friction and wear, using pin of disc setup.

Table 5: Friction & Wear Test Reading

Work pieces	Track Radius	By Time in Min	By load in Kg	Speed in (RPM)	Frictional Force in (N)	Wear in (Micron)	Co-efficient of friction
Sample1 (Al97%+SiC2%+Gr1 %)	30	30	2	1200	11	109	0.37
			3	1250	13	111	0.43
Sample2 (Al97%+SiC1%+Gr2 %)	30	30	2	1200	10	76	0.48
			3	1250	12	49	0.40

SAMPLE 1(2 kg load)

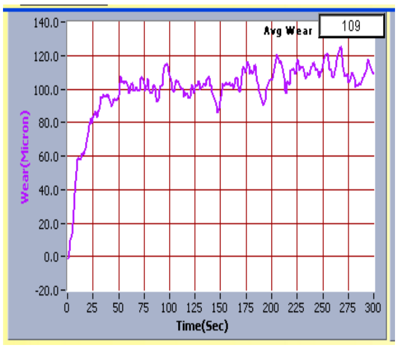

Figure 3: Wear

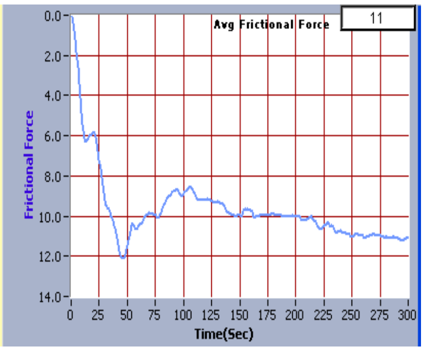

Figure 4: Friction Force

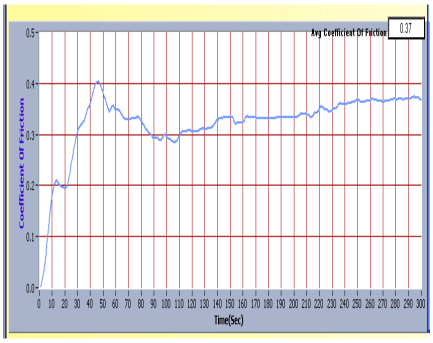

Figure 5: Coefficient of Friction

SAMPLE 1(3 Kg Load)

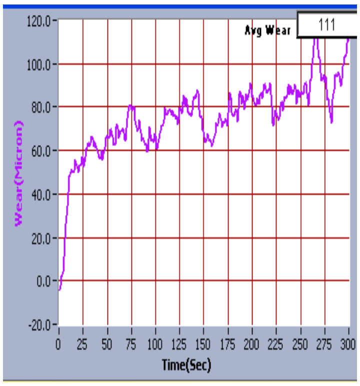

Figure 6: Wear

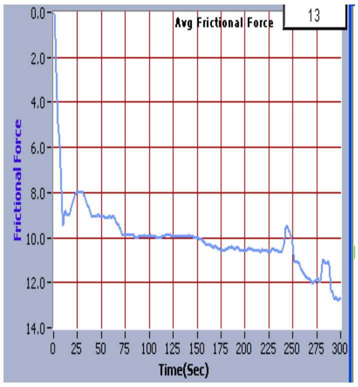

Figure 7: Friction Force

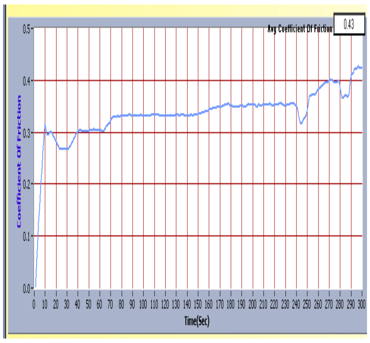

Figure 8: Coefficient of Friction

SAMPLE 2(2 kg Load)

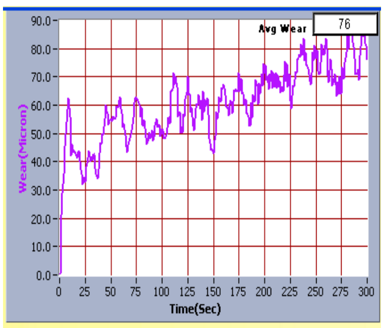

Figure 9: Wear

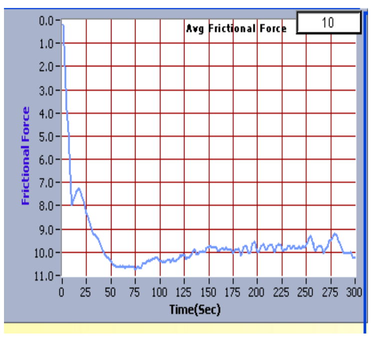

Figure 10: Friction Force

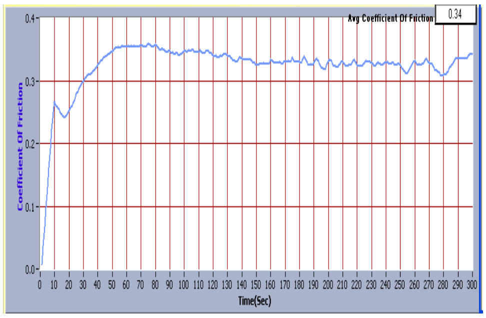

Figure 11: Coefficient of Friction

SAMPLE 2(3 kg Load)

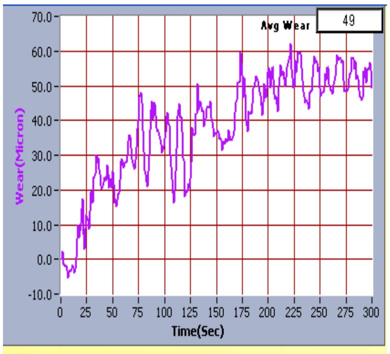

Figure 12: Wear

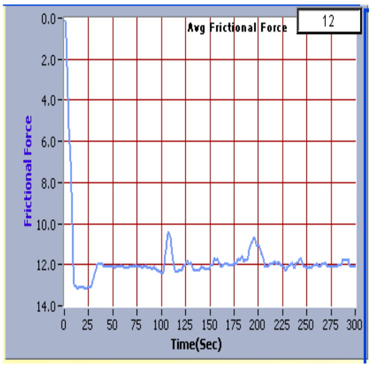

Figure 13: Friction Force

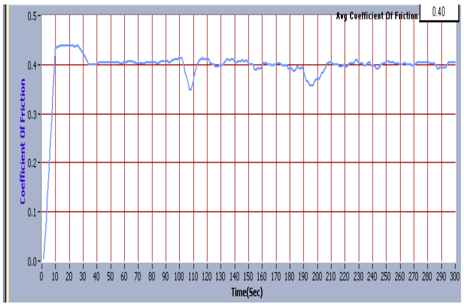

Figure 14: Coefficient of Friction

In this work, AA6061 brake drum was dispersed with different contents of reinforcement of SiC-(1%, 2%), Gr-(2%, 1%), and fabricated by using the stir casting technique. The above discussion deals with testing their properties. The wear rate will be affected due to the applied load and the sliding distance of the material, and it should be reduced.

The wear rate of the material will be increased, if the load applied increases for lll the alloys. Wear rate increases linearly at low loads and while increasing the sliding distance, it will be increased. The size and shape of the aluminium alloy powders depend on the cooling rate, flow rate of the cooling medium and the surface tension of aluminium alloy melt. The Second sample shows the reduced wear rate, comparatively better than the first Sample.

CONCLUSIONS

In this work, high strength to weight ratio for Al alloy 6061 with Sic + Gr is obtained. Wear rate is reduced by varying the reinforcement material with the different proportions. It is the trial and error method, we have started the work with slight variation in the proportion. The minimum wear rate and good strength has been obtained at AA6061 97% Sic

1%& Gr 2% ratio. This indicates that this material exhibits less weight with high Strength, and it is very convenient to use in all the type of Practical applications.

REFERENCES

1. *Brijendra Gupta, Ashish Jashvantlal Modi " Review of automotive brake friction materials" International Journal of Advance Engineering and Research Development, volume 2, issue 2, February -2015.*
2. *Harish K.Garg, KetanVerma, Alakesh Manna, Rajeshkumar "Hybrid metal matrix composites and further improvement in their machinability - A Review" International Journal of Latest Research in Science and Technology vol.1,issue 1 :36-44, May-June-2012*
3. *M. Asif, K. Chandra, P. S. Misra "Development of Aluminium based hybrid metal matrix composites for heavy duty applications" Journal of Minerals & Materials Characterization & Engineering, vol.10, no.14, pp.1337-1344, 2011.*
4. *Michael OluwatosinBodunrin, Kenneth KanayoAlaneme, Lesley heath chown, "Aluminium matrix hybrid composites: a review of reinforcement philosophies: mechanical, corrosion and tribological characteristics" Journal of Materials Research and Technology. vol. no 10, no 3, February 2 0 1 5*
5. *Rajesh purohit, R. S. Rana and C. S. Verma "Fabrication of Al-SiC composites through powder Metallurgy Process and Testing of Properties" International Journal of Engineering Research and Applications, vol. 2, issue 3, May-June 2012.*
6. *S.Das "Development of Aluminium alloy composites for engineering applications" Trans. Indian inst. met. Vol.57, no. 4, august 2004.*
7. *P. Manoj Kumar et al.,, Development and Study of Tribological Properties of Biocomposite for Brake Pad Application, International Journal of Mechanical and Production Engineering Research and Development (IJMPERD), Volume 7, Issue 6, November - December 2017, pp. 263-270*
8. *S. O. Adeosun, l. O. Osoba, o. O. Taiwo " Characteristics of aluminum hybrid composites" World Academy of Science Engineering and Technology International Journal of Chemical, Molecular, Nuclear, Materials and Metallurgical Engineering vol 8, no 7, 2014.*
9. *Sourav Das, AmeenurRehmanSiddiqui, VishvendraBartaria "Evaluation of aluminum alloy brake drum for automobile application" International Journal of Scientific & Technology Research, volume 2, issue 11, November 2013.*
10. *Parthipan, N. Prasanna, S.C., Balamurugan, R., Manikandan, A., Optimization parameters of drilling process in electric discharge machining used in SS317 material, Pakistan Journal of Biotechnology, ISSN: 2312-7791, Vol - 14, pp 99-102*
11. *Manikandan, C. Gokulkumar, N. Parthipan, Effect of Hardness and Tensile properties of Al6061 based composites for Piston alloy using Stir casting method, Journal of Chemical and Pharmaceutical Sciences, ISSN: 0974-2115, Issue 3, pp 24-27*